NIUF/401-92

Application Profile (920006)

ISDN CPE Compatibility: ISDN Telephone/Workstation Integration

(CPE-CC 90.003)

Approved: February 1992

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1 User Description of the Application

This section is a summarization of the information in the Application Analysis.

Table 1. Functional Requirements

Feature	ISDN Telephone	Workstation
Voice call handling:	Yes	Yes
Call origination	Yes	Yes
Call termination	Yes	Yes
Voice communication	Yes	No
Voice supplementary service activation:		
Hold	Yes	Yes
Transfer	Yes	Yes
Conference	Yes	Yes
Electronic key telephone service	Yes	Yes
Call pick up	Yes	Yes
Automatic call back	Yes	Yes
Calling number identification	Yes	Yes
Telephone local function control:		
Speaker phone activation	Yes	No
Speaker phone mute	Yes	No
ISDN telephone data call control:		
D Channel packet switch calling	Option	No
B Channel packet switch calling	Option	No
B Channel circuit switch calling	Option	No
Workstation data call control:		
D Channel packet switch calling	No	Yes
B Channel packet switch calling	No	Yes
B Channel circuit switch calling	No	Yes
Workstation local function control:		
Call monitoring & logging	No	Yes
Directory service	No	Yes

Notes on the Functional Requirements:

(1) An answer of "Yes" means that support for this feature is required.

(2) An answer of "Option" means that support for this feature appears desirable but may not be required.

(3) An answer of "No" means that support for this feature is not to be provided.

(4) It must be possible to originate or answer a call from either the ISDN Telephone or the Workstation. conversation takes place only on the ISDN telephone.

(5) It should be possible to activate Voice Supplementary Features from either the ISDN Telephone or the Workstation. This requirement will probably have impact on the Hold, Electronic Key Telephone Service (EKTS), Conference, and Transfer features.

(6) There was no user requirement for the Workstation to control the local telephone functions, e.g., speaker phone; however, it may be desirable for the workstation to be able to control the speaker phone in particular.

(7) It is possible that the ISDN Telephone will include an integrated terminal adapter. The assumption in this case is that the Workstation would have no control over this terminal adapter.

(8) The ISDN Telephone would have no control over the Workstation's ISDN data calling.

(9) The ISDN Telephone would not be required to provide functions best provided in the Workstation, e.g., call monitoring, call logging or directory services. However, some of these services may involve voice call handling functions, e.g., call origination.

2 Application Decomposition

This application will be composed of a single process. This Application Process is described in the remainder of this section.

2.1 Application Process Description

This Application Process handles all of the call-related activities. These include:

- Call Origination at the ISDN Telephone
- Call Origination at the ISDN Workstation
- Voice Communication at the ISDN Telephone
- Supplementary Service Control at the ISDN Telephone
- Supplementary Service Control at the ISDN Workstation
- Call Termination at the ISDN Telephone
- Call Termination at the ISDN Workstation
- Call Monitoring

3 Service Logic

Figure 1 shows the Service Logic for this application and how the above functions operate.

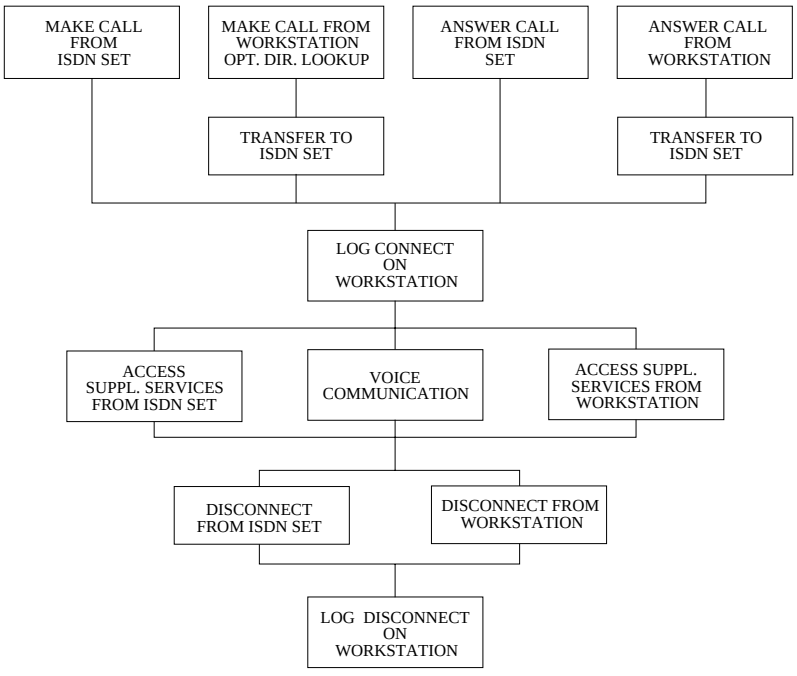


Figure 1. Service Logic.

4 Call Handling Application Process (Alternatives)

This section includes a general description of the alternative architectures that have been currently defined. In order to improve the clarity of this document the detailed implementations proposed are put in separate sections. Section 5 details an alternative architecture that is based on using the R interface of the ISDN Telephone to connect the ISDN Workstation to the network. Section 6 details the EKTS-based architecture. Future sections will be added based on contributions to the NIUF.

4.1 Application Process Description

This Application Process handles all of the call-related activities. These include:

- Call Origination at the ISDN Telephone
- Call Origination at the ISDN Workstation
- Voice Communication at the ISDN Telephone
- Supplementary Service Control at the ISDN Telephone
- Supplementary Service Control at the ISDN Workstation
- Call Termination at the ISDN Telephone
- Call Termination at the ISDN Workstation
- Call Monitoring

4.2 Alternative Architectures

Five potential architectures to implement this application have been identified. The primary difference is in which network element provides the control and how information is communicated between the ISDN Telephone and the workstation.

Overall Issues:

(1) Each implementation must provide a method for communicating control information between the ISDN Telephone and the Workstation.

(2) The communication method between the ISDN Telephone and the Workstation must include the ability to communicate call state information for each active call. This will be required to insure proper coordination of basic call and supplementary service call control between the ISDN Telephone and the Workstation.

4.2.1 ISDN Interface to the Workstation

See **Figure 2**.

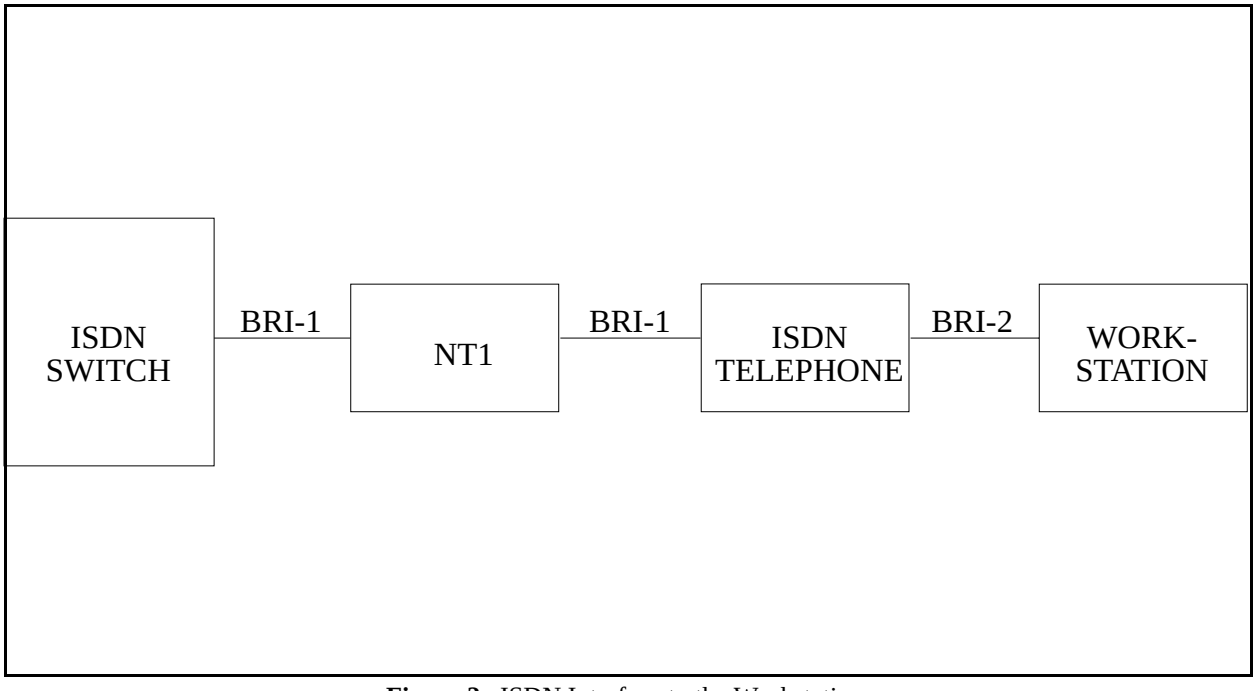


Figure 2. ISDN Interface to the Workstation.

Implementation Requirements:

(1) No modifications required to the switch.

(2) The ISDN Terminal may be implemented as an NT2 and must provide the physical interface and all of the signalling required to the Workstation to support the Functional Requirements.

(3) The Workstation must have an integrated ISDN TA along with software to support the Functional Requirements.

Implementation Issues:

(1) While this architecture is reasonably well defined in standards, it may not be desirable because the implementation of NT2 functionality in an ISDN telephone may have significant cost implications.

4.2.2 R Interface to the Workstation

See **Figure 3**.

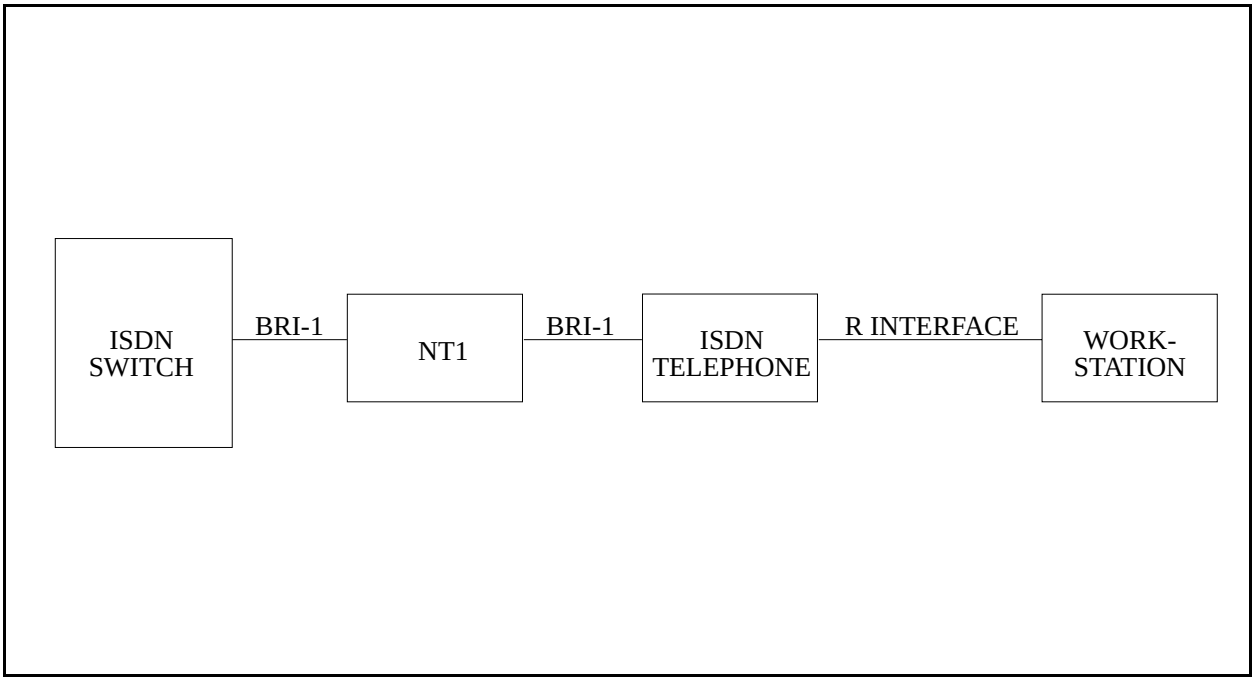


Figure 3. R Interface to the Workstation.

Implementation Requirements:

(1) No modifications required to the switch.

(2) The ISDN Telephone must implement a protocol to provide all of the signalling required to the Workstation to support the Functional Requirements.

(3) The Workstation must have the appropriate R Interface and implement the ISDN Telephone's protocol along with software to support the Functional Requirements.

Implementation Issues:

(1) The protocol on between the ISDN Telephone and the Workstation must be standardized for implementation.

See section 5 for a detailed analysis of this architecture.

4.2.3 ISDN Interface to the ISDN Telephone

See **Figure 4**.

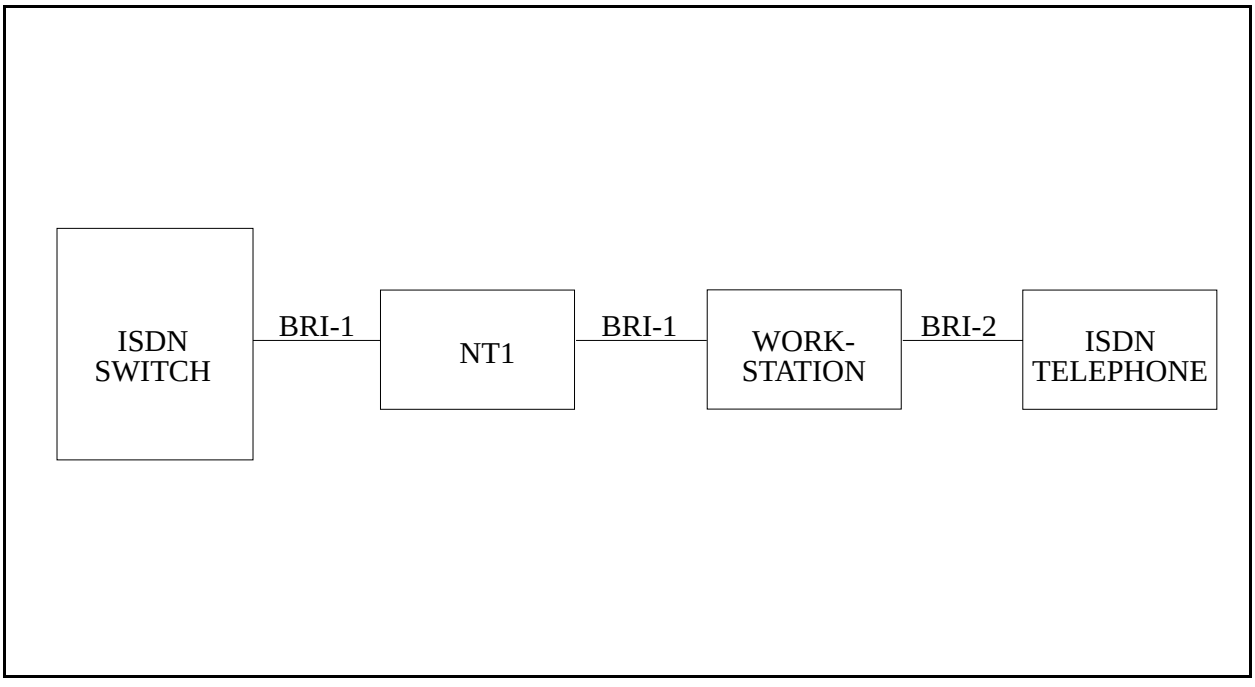


Figure 4. ISDN Interface to the ISDN Telephone.

Implementation Requirements:

(1) No modifications required to the switch.

(2) No modifications required to the ISDN Telephone assuming it supports the STATUS ENQUIRY and STATUS messages (note: these messages are not included in NIUF.

(3) The Workstation may be implemented as an NT2 and must provide the physical interface and all of the signalling required to the ISDN Terminal along with appropriate software to support the Functional Requirements.

Implementation Issues:

(1) While this architecture is reasonably well defined in standards, it may not be desirable because the implementation of NT2 functionality in a Workstation may have significant cost implications.

4.2.4 Control in the Switch

See **Figure 5**.

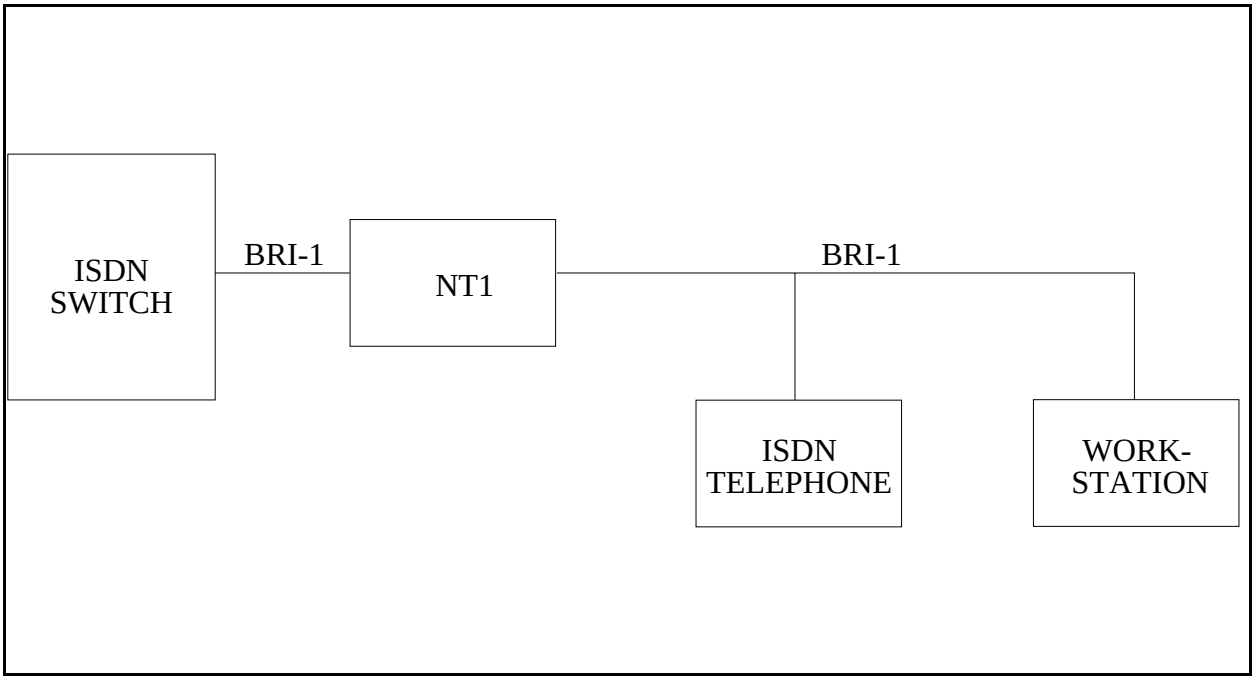


Figure 5. Control in the Switch.

Implementation Requirements:

(1) Modifications are required to the switch to implement a protocol to provide communication between the ISDN Telephone and the ISDN Workstation. (The Northern Telecom SAPI 17 implementation is an example of such a protocol.)

(2) No modifications required to the ISDN Telephone.

(3) The Workstation must have an integrated ISDN TA, along with software, use the signalling from the NT1 to support the Functional Requirements.

Implementation Issues:

(1) There are no standards defined that support the implementation of the control and association functions on the switch.

4.2.5 Electronic Key Telephone System Base

See **Figure 6**.

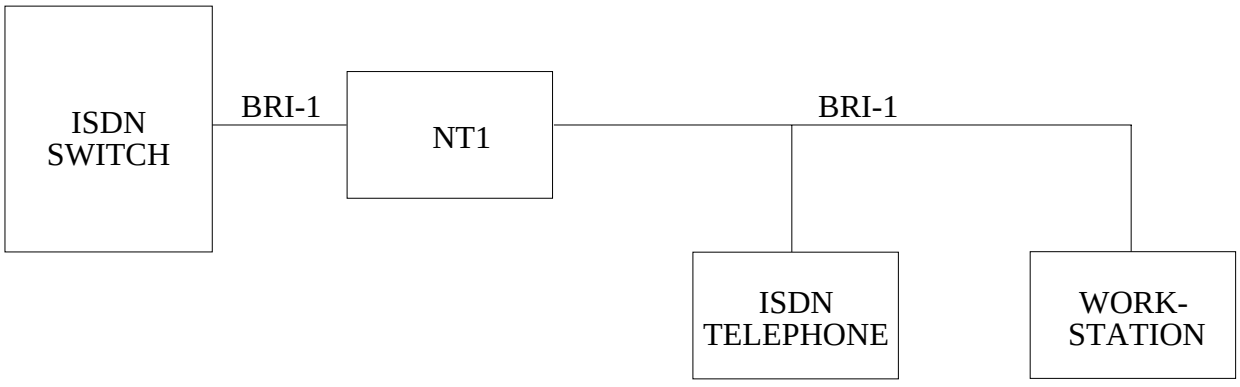


Figure 6. Electronic Key Telephone System Base.

Implementation Requirements:

(1) The switch must support an EKTS.

(2) The ISDN Telephone must support an EKTS.

(3) The Workstation must have an integrated ISDN TA that supports all voice and data services, including EKTS. This TA must also provide for monitoring of all D Channel Signalling traffic on the Digital Subscriber Loop (DSL). The workstation will also require software that will use this monitoring information to support the Functional Requirements.

Implementation Issues:

(1) The TA will use the Electronic Key System Simulation (EKTS) feature of the ISDN Switch to provide the ability to originate and terminate calls.

See section 6 for a detailed description of this approach.

4.3 Interoperation

Each of the above alternative architectures deals only with the local relationship of the Workstation, the ISDN Telephone, and the network. That is, it is independent of how calls are managed with any other terminal or terminals connected to the network. This means that any or all of the architectures described above can be connected to the network at one time and can interoperate with each other and with any other ISDN or non-ISDN terminal connected to the network in appropriate ways. This means that the user can select from the above architectures on an individual basis.

5 Applications Process Description—R Interface

This section details an alternative architecture that is based on using the R interface of the ISDN Telephone to connect the ISDN Workstation to the network. The advantages of this approach are that it has lower hardware cost and it does not require any changes to ISDN interfaces. A limitation of this approach is that the data transfer rate is limited to the maximum allowed by the R interface.

5.1 Applications Process Description

See Section 2.1 for the description of the Call Handling Application Process.

This Applications Process handles all of the call-related activities. These include:

- Call Origination at the ISDN Telephone
- Call Origination at the ISDN Workstation
- Voice Communication at the ISDN Telephone
- Supplementary Service Control at the ISDN Telephone
- Supplementary Service Control at the ISDN Workstation
- Call Termination at the ISDN Telephone
- Call Termination at the ISDN Workstation
- Call Monitoring

5.2 Architecture

This alternative architecture uses the R interface on the ISDN telephone to connect to a serial port on the workstation. It uses a standard ISDN protocol interface to the ISDN Telephone. This architecture requires the development of a standard for the R Interface to provide a method to control the operation of the ISDN Telephone from the Workstation. See **Figure 7**.

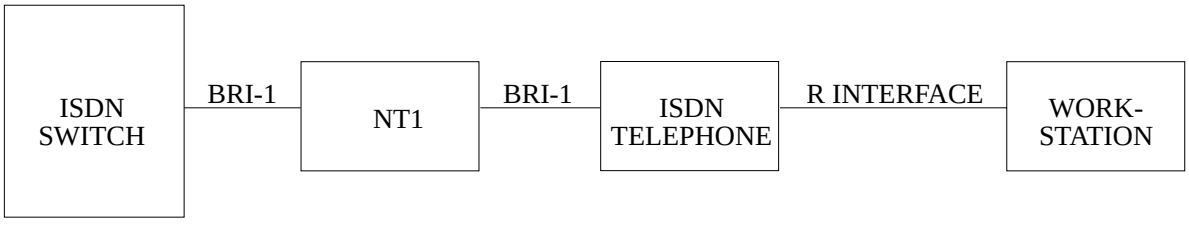


Figure 7. R Interface Architecture.

5.2.1 ISDN Interface

This section describes the requirements for the ISDN interface point. It can be implemented using current standards.

5.2.1.1 Layer 1 Architecture

The Layer 1 Architecture for this alternative is fully supported by NIUF 92-101R1 and NIUF 92-105R1.

5.2.1.2 Layer 2 Architecture

The Layer 2 Architecture for this alternative is fully supported by NIUF 89-210.

5.2.1.3 Layer 3 Architecture

The Layer 3 Architecture for this alternative is fully supported by NIUF 90-301.

5.2.1.4 Supplementary Service Architecture

The Supplementary Service Architecture for this alternative is based on NIUF 90-311 (see section 3.1.4.1.2).

5.2.2 R Interface Architecture

A signalling architecture needs to be defined that will provide support for call control from the Workstation. This interface would use the physical interface provided by the ISDN Telephone and the Workstation. This architecture needs to provide the following functions:

- Call Origination (Telephone)
- Call Origination (Workstation)
- Voice Communication (Telephone)
- Supplementary Service Control (Telephone)
- Supplementary Service Control (Workstation)
- Call Termination (Telephone)
- Call Termination (Workstation)
- Notification of Call State Changes for Call Monitoring
- Circuit Switched Data Call Control (Workstation)
- Packet Switched Data Call Control (Workstation)

An example for this kind of interface is the "Hayes Standard AT Command Set for ISDN," published by Hayes Microcomputer Products, Inc.

5.3 Information Flow Diagrams

Either the ISDN Telephone or the Workstation could be used to originate calls or to terminate calls. The R interface protocol provides the signalling required to communicate the state of the call to the ISDN Telephone and the Workstation. The general procedures for handling calls from the ISDN Telephone do not change. The procedure for originating a call from the Workstation and conversing on the ISDN Telephone along with accessing Supplementary Services either from the ISDN Telephone or the Workstation is given in **Figure 8**. The details of the signalling protocol are not shown in order to improve clarity.

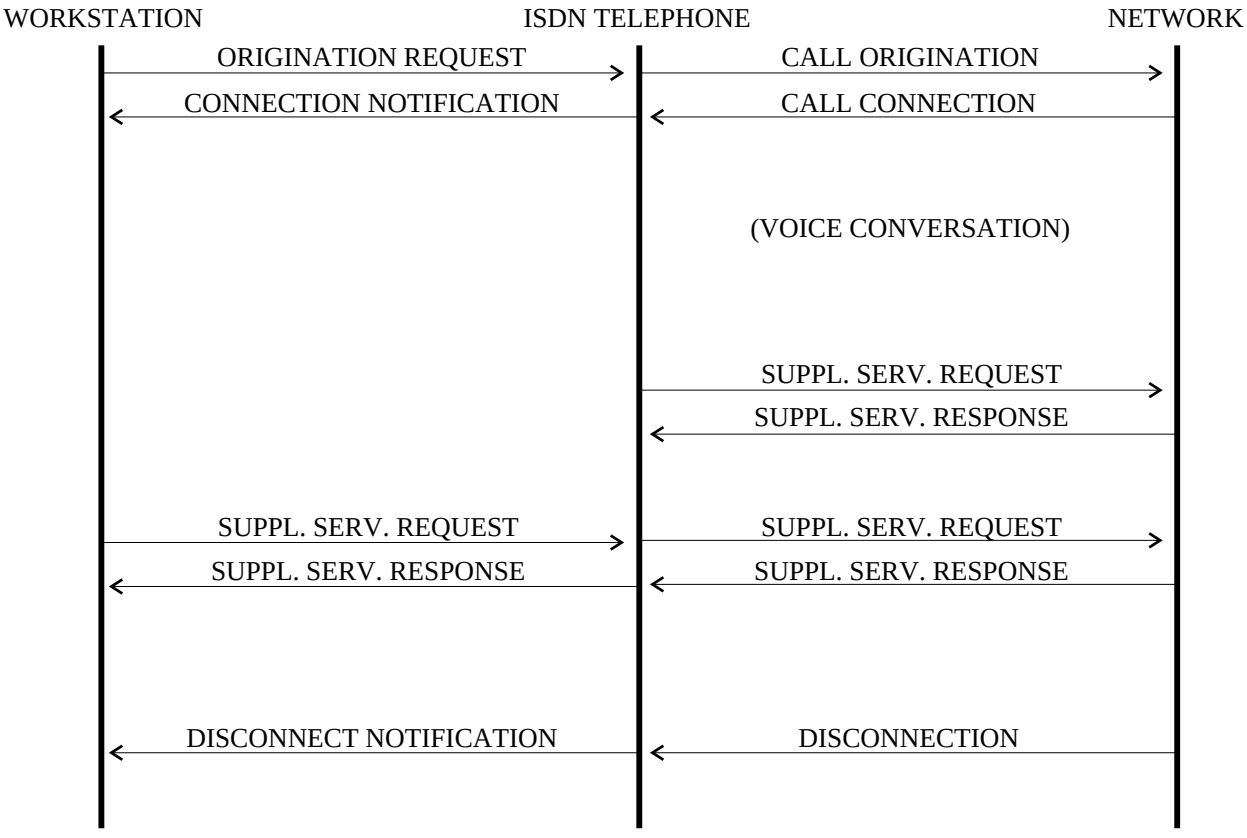


Figure 8. Accessing Supplementary Services—Information Flow Diagram.

5.4 SDLs

SDLs are not required for this Application Profile.

5.5 Standard Protocol Requirements

The following implementation agreements apply to this alternative architecture:

- NIUF 90-301
- NIUF 90-311
- NIUF 89-210
- NIUF 92-101R1
- NIUF 92-105R1

This alternative architecture requires the definition of a standard for an R Interface Protocol as described in Section 5.2.2 above.

5.6 Conformance Criteria

This section contains a general description of the conformance requirements for this alternative architecture.

5.6.1 Protocol Conformance Requirements

An implementation of this alternative architecture should conform to the Protocol Requirements described in Section 5.5 above.

5.6.2 Functional Conformance Requirements

Meet the functional requirements described in Section 1, User Description of the Application.

6 Application Process Description—EKTS

This section details the EKTS-based architecture. The advantage of this approach is that it permits the Workstation to transfer data at a full 64 kbps. A disadvantage is that it requires an ISDN telephone and a separate ISDN interface in the workstation; this approach is likely to have a higher cost associated with it.

6.1 Application Process Description

This Application Process handles all of the call-related activities. These include:

- Call Origination at the ISDN Telephone
- Call Origination at the ISDN Workstation
- Voice Communication at the ISDN Telephone
- Supplementary Service Control at the ISDN Telephone
- Supplementary Service Control at the ISDN Workstation
- Call Termination at the ISDN Telephone
- Call Termination at the ISDN Workstation
- Call Monitoring

6.2 Architecture

This alternative architecture uses the EKTS feature to provide ISDN Telephone/Workstation Integration. This approach has the advantage that it can be implemented using standard ISDN Telephones, Workstations ISDN interface boards, and ISDN Networks as long as each supports the EKTS feature. The monitoring function may require specific hardware support. See **Figure 9**.

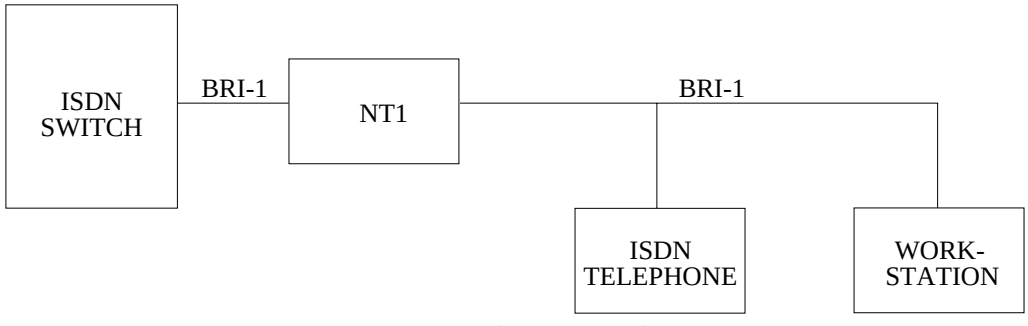


Figure 9. EKTS Alternative Architecture.

6.2.1 ISDN Telephone Architecture

This architecture assumes that no modifications would be required of the ISDN Telephone. It assumes that any ISDN Telephone that fully supports EKTS would be compatible with this application.

6.2.2 Workstation Architecture

This architecture assumes that the Workstation would have a Basic Rate Interface along with application software that would support the requirements of this application.

The Basic Rate Interface would have the following capabilities:

- Full control of voice calls including all supplementary services
- Support for EKTS as a mandatory requirement
- Ability to monitor all messages for all terminals connected to the same DSL

The Applications Software should be able to support all of the Functional Requirements of the application, including:

- Call Origination
- Call Termination
- Activation and Control of Supplementary Services
- Full Data Communications Capability
- Directory Services
- Call Monitoring and Call Logging

6.2.3 Protocol Architecture

This architecture uses a standard three-layer ISDN protocol architecture with the addition of supplementary services signalling in layer 3.

6.2.3.1 Layer 1 Architecture

The Layer 1 Architecture for this application is fully supported by NIUF 92-101R1 and NIUF 92-105R1. The physical configuration options will be determined by the configuration limitations of the EKTS feature. There is a requirement to connect the ISDN Telephone and the Workstation to the same Digital Subscriber Line (DSL) to meet the monitoring requirements of this application. Consequently support for the Point-to-Multi-point configurations is a requirement for this application.

6.2.3.2 Layer 2 Architecture

The Layer 2 Architecture for this application is fully supported by NIUF 89-210. There are no special Layer 2 issues for this application.

6.2.3.3 Layer 3 Architecture

The Layer 3 Architecture for this application is fully supported by NIUF 90-301 for basic call control. It also uses NIUF 90-301 (Appendix A) for supplementary Services signalling.

6.2.4 Supplementary Service Architecture

The Supplementary Service signalling architecture for this application is based on NIUF 90-311 (see section 3.1.4.1.2). This architecture requires the support of the EKTS feature and has certain feature interaction requirements between EKTS and other supplementary services. Supplementary services where this may be an issue are described explicitly.

6.2.4.1 Electronic Key Telephone Service

An EKTS feature is required that supports shared call appearances between two ISDN terminals. A discussion of one implementation of EKTS can be found in Bellcore's TR-TSY-000205 "ISDN Electronic Key Telephone Service." A fundamental part of the EKTS feature is the "Call Appearance Group." A Call Appearance group is the set of ISDN Terminals that can originate or terminate calls from a given Directory Number (DN).

This application assumes that a terminal with a shared call appearance will be notified of any of the following events:

- Incoming Call Termination
- Incoming Call Connected
- Outgoing Call Initiation
- Call Put on Hold
- Call Retrieved from Hold
- Call Disconnected from all Members of the Call Appearance Group

In addition, any Terminal in the Call Appearance Group should have the capability to:

- Originate a Call
- Terminate a Call
- Connect to a Call
- Place an Active Call on Hold
- Retrieve a Held Call

These capabilities allow the integration of functions from the ISDN Telephone to the ISDN Workstation.

6.2.4.2 Conference Calling

It must be possible to access a Conference Call from any terminal that shares a Call Appearance that is part of the Conference. This allows the ISDN Telephone to connect to a Conference Call that has been initiated from the Workstation.

It is desirable, but not required, that a Conference Call initiated on one Terminal in a Call Appearance Group be controllable from any other terminal in the Call Appearance Group. This would allow the control of the Conference Call to move easily from the ISDN Telephone and Workstation and back again.

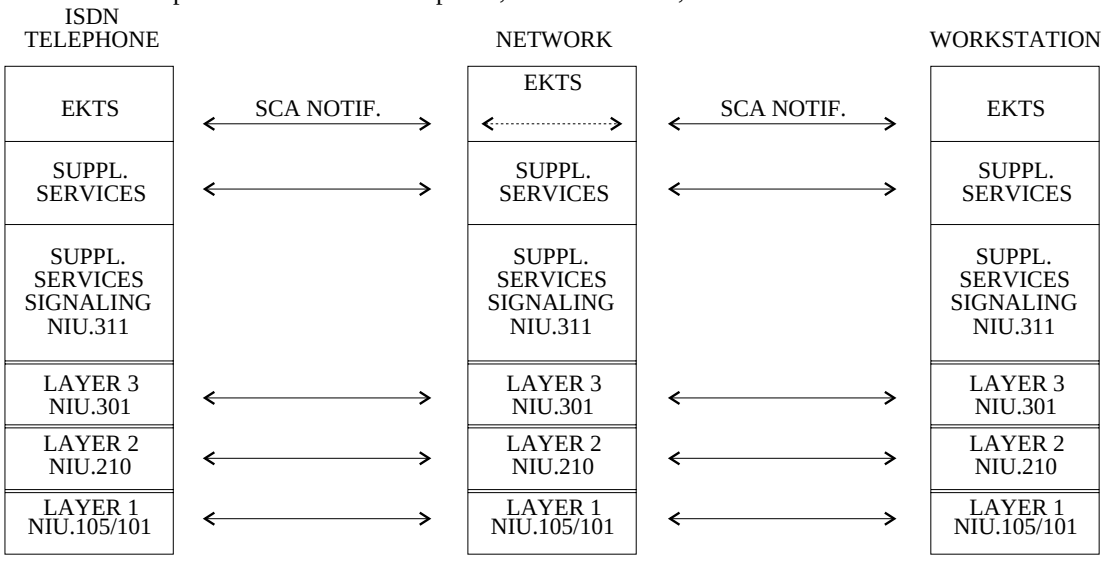
6.2.4.3 Other Supplementary Services

It must be possible to operate all Supplementary Services from any terminal that shares a Call Appearance. This allows the ISDN Telephone and the Workstation to operate features on a cooperative basis.

It is desirable but not required that any feature that is initiated on one Terminal in a Call Appearance Group can have the feature interaction continue from any other member of that Call Appearance Group. This would allow the activation of the feature to move easily from the ISDN Telephone and Workstation and back.

6.2.5 Protocol Stack

The protocol stack shown in **Figure 10** illustrates the peer-to-peer communications in the Architecture described above. It shows the relationship between the ISDN Telephone, the Workstation, and the Network.



NOTES:

1. SCA NOTIF. means Shared Call Appearance Notification. The arrows are drawn through the network to show the quasi "end-to-end" nature of the communication.

2. All other connections are between the Network and the ISDN Telephone or Workstation and not end-to-end from the ISDN Telephone to the Workstations.

Figure 10. Protocol Stack.

6.3 Information Flow Diagrams

Either the ISDN Telephone or the Workstation could be used to originate calls or to terminate calls. The EKTS protocols would provide the signalling required to communicate the state of the call to the ISDN Telephone and the Workstation. It is assumed that the Workstation would not support voice communication so the conversation would be held only from the ISDN Telephone. The general procedures for handling calls from the ISDN Telephone do not change. The procedure for originating a call from the Workstation and conversing on the ISDN Telephone is given in **Figure 11**. The details of the signalling protocol are not shown in order to clarify the general flow.

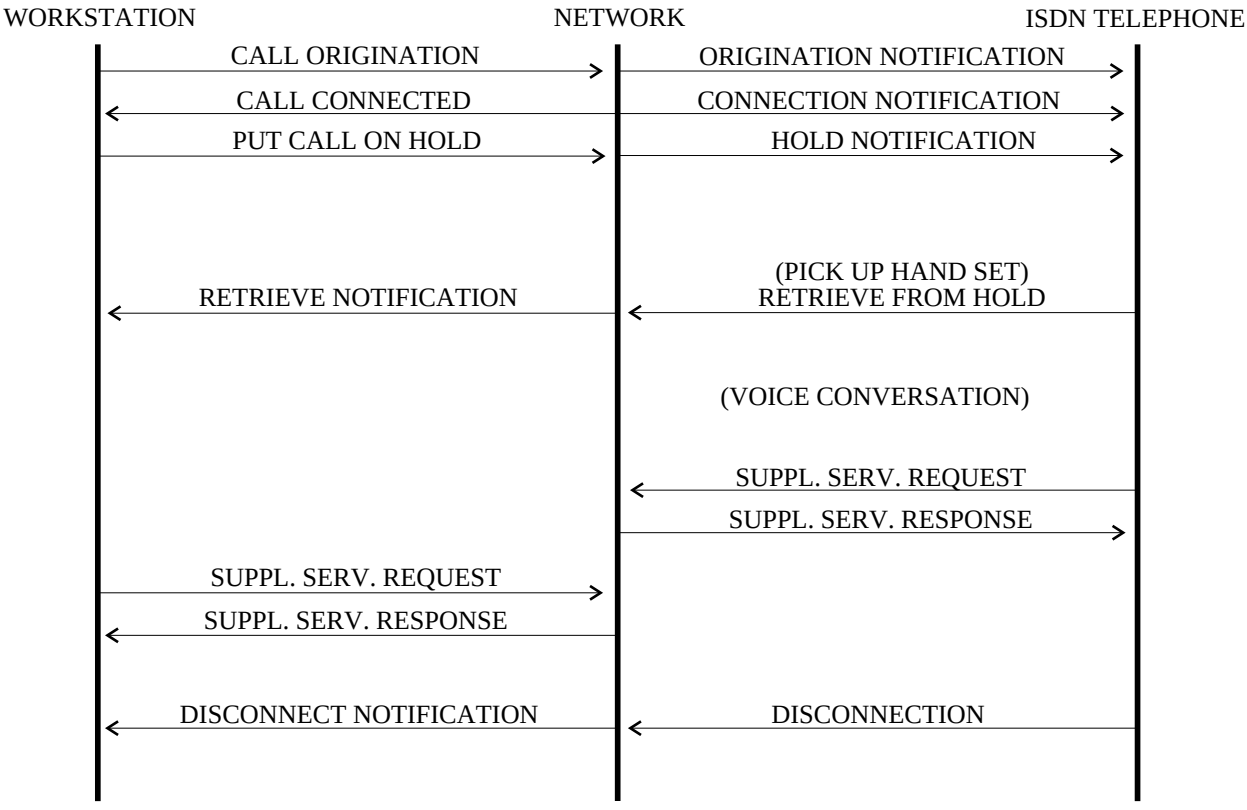


Figure 11. ISDN Telephone Call Originating from Workstation—Information Flow Diagram.

6.4 SDLs

There is no requirement for SDLs in this application profile.

6.5 Standard Protocol Requirements

The following implementation agreements apply to this Alternative Architecture:

- NIUF 90-301
- NIUF 89-311
- NIUF 89-210
- NIUF 92-101R1
- NIUF 92-105R1

This alternative architecture requires the definition of a standard for an Electronic Key Telephone System feature as described in Section 6.2.4.1 above.

6.6 Conformance Criteria

This section contains a general description of the conformance requirements for this alternative architecture.

6.6.1 Protocol Conformance Requirements

An implementation of this alternative architecture should conform to the Protocol Requirements described in Section 6.5 above.

6.6.2 Functional Conformance Requirements

An implementation of this alternative architecture should meet the functional requirements described in Section 1, User Description of the Application.